

12

**EUROPEAN PATENT APPLICATION**

21 Application number: 90103275.5

51 Int. Cl.<sup>5</sup>: **B60K 41/06**

22 Date of filing: 20.02.90

30 Priority: 21.02.89 JP 42170/89

43 Date of publication of application:  
29.08.90 Bulletin 90/35

84 Designated Contracting States:  
**DE FR GB**

71 Applicant: **Mazda Motor Corporation**  
**No. 3-1, Shinchu Fuchu-cho**  
**Aki-gun Hiroshima-ken(JP)**

72 Inventor: **Kikuchi, Toshiyuki**  
**1032-1, Miyaryo, Takaya-cho**  
**Higashihoroshima-shi, Hiroshima-ken(JP)**  
Inventor: **Fujii, Masaki**  
**16-19-304, Hamada 2-chome, Fuchu-cho**  
**Aki-gun, Hiroshima-ken(JP)**  
Inventor: **Abe, Mitsutoshi**  
**9-9, Miyanomachi 2-chome, Fuchu-cho**  
**Aki-gun, Hiroshima-ken(JP)**  
Inventor: **Matsuno, Yuji**  
**4-15-20, Ujinakanda, Minami-ku**  
**Hiroshima-shi, Hiroshima-ken(JP)**

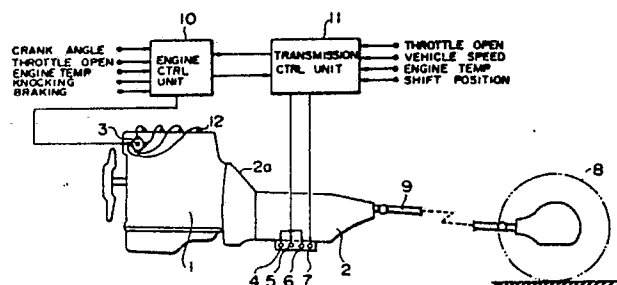
74 Representative: **Patentanwälte Deufel- Schön-**  
**Hertel- Lewald- Otto**  
**Isartorplatz 6**  
**D-8000 München 2(DE)**

54 **Control system for vehicle with automatic transmission.**

57 A control system for a vehicle including an automatic transmission provided with multiple transmission gear mechanism in which a specific gear stage of a speed ratio is automatically established among a plurality of gear stages in accordance with an vehicle operating condition, shift control signal producing device for producing a shift control signal in order to make a shift operation between different gear stages in accordance with the vehicle operation condition, engine output control device for reducing an engine output in synchronism with the shift operation so as to suppress a torque shock due to the shift operation, detecting device for detecting a specific vehicle operation condition in which a change in a time lag between a generation of the shift control signal and an actual initiation of the shift operation in the transmission is greater than a predetermined level and for producing a signal denoting the specific vehicle operating condition, and restricting device for

restricting the engine output control device from reducing the engine output when said specific vehicle operating condition is detected. The torque shock due to the shift operation can be effectively suppressed.

**FIG. 1**



## CONTROL SYSTEM FOR VEHICLE WITH AUTOMATIC TRANSMISSION

### CROSS-REFERENCE TO THE RELATED APPLICATION

The present application relates to a U.S. Patent application filed on February 17, 1990 in the name of the same assignee as the present application under the title of "ENGINE CONTROL SYSTEM FOR VEHICLE WITH AUTOMATIC TRANSMISSION".

### BACKGROUND OF THE INVENTION

#### Field of the invention

The present invention relates to a control system for an internal combustion engine of a vehicle with an automatic transmission, more specifically to an output control of the engine in connection with a shift operation in the automatic transmission.

#### Description of the prior art

In a vehicle provided with an automatic transmission, there have been various proposals for reducing a torque shock or jolt through a shift operation from one gear stage to another in the automatic transmission. In a control system disclosed in U.S. Patent No. 4,226,447, an ignition timing of the engine is controlled in accordance with a vehicle speed as a shift operation occurs so that an engine output power or torque is changed to reduce the torque shock due to the shift operation. U.S. Patent Nos. 4,355,550, 4,370,903 and 4,403,527 disclose similar control systems.

In controlling the engine output during the shift operation, it should be noted that there is produced a time lag from a generation of a control signal for the shift operation to an actual initiation of the shift operation. In order to reduce the torque shock due to the shift operation effectively, it is desirable that the engine output control is made corresponding to the actual shift operation.

In view of this, the conventional ignition timing output control is adapted to be initiated to control the engine output torque after a predetermined time period from the generation of the control signal for the shift operation so that the engine output control occurs in synchronism with an actual shift operation.

It should however be noted that the time lag from the generation of the control signal for the shift operation to the actual initiation of the shift

operation varies depending on a vehicle operating condition such as engine speed, engine load defined such as a throttle opening, intake gas amount and the like, line hydraulic pressure in the transmission, gear stages involved in the shift operation and the like.

Specifically, a viscosity of a hydraulic fluid or oil in the transmission affects greatly the time lag since the shift operation is made in a manner that a specific gear stage is established by switching a power transmitting path in the transmission by virtue of the hydraulic fluid. Thus, where the viscosity of the hydraulic fluid is high, the shift operation may take long and become unstable. As a result, the engine output control may not correspond to the actual shift operation. This means that the torque shock due to the shift operation cannot be suppressed effectively because of the untimely engine output control. Moreover, the engine output control may deteriorate controllability (for example an acceleration property) of the vehicle under the vehicle operating condition where the temperature of the hydraulic fluid is low.

### SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a control system which can accomplish an improved controllability of a vehicle with an automatic transmission even where the vehicle is in an operating condition where a time lag between a shift control signal for the transmission and an actual shift operation varies greatly.

It is another object of the present invention to provide a control system which can suppress a torque shock due to a shift operation of an automatic transmission effectively.

The above and other objects of the present invention can be accomplished by a control system for a vehicle including an automatic transmission provided with a multiple transmission gear mechanism in which a specific gear stage of a speed ratio is automatically established among a plurality of gear stages in accordance with an vehicle operating condition, shift control signal producing device for producing a shift control signal in order to make a shift operation between different gear stages in accordance with the vehicle operating condition, engine output control device for reducing an engine output in synchronism with the shift operation so as to suppress a torque shock due to the shift operation, detecting device for detecting a specific vehicle operating condition in which a change in a time lag between a generation of the shift control

signal and an actual initiation of the shift operation in the transmission is greater than a predetermined level and for producing a signal denoting the specific vehicle operating condition, and restricting device for restricting the engine output control device from reducing the engine output when said specific vehicle operating condition is detected.

Preferably, the engine output control means is constituted by ignition timing control means for controlling an ignition timing of the engine. More specifically, the ignition timing control means retards the ignition timing in response to the shift operation.

According to the present invention, a retard control signal for retarding the ignition timing is produced after a predetermined time period from a generation of a shift control signal for effecting the shift operation.

Typically, a final ignition timing is calculated in accordance with a basic ignition timing which is determined based on an engine operating condition defined by such as engine speed, engine load, engine temperature and the like, a shift compensating value which is determined to reduce a torque shock due to the shift operation, and a knock compensating value which is determined to eliminate an engine knocking. The final ignition timing is compensated by a greater one of the shift compensating value and the knock compensating value.

According to the present invention, the engine output control is restricted or not carried out under a vehicle operation condition where the viscosity of the hydraulic fluid in the transmission is relatively high. The viscosity can be known by detecting a temperature of the hydraulic fluid or a running distance after starting the engine in the current driving operation.

The above and other features of the present invention will be apparent from the following description taking reference to the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic view of a power plant of a vehicle with an automatic transmission to which an engine control system in accordance with the present invention can be applied;

Figure 2 is a flow chart of a shift control in a transmission control unit;

Figure 3 is a flow chart of an ignition timing control in an engine control unit;

Figure 4 is a flow chart of a procedure for obtaining a knocking retard angle in the engine control unit;

Figure 5 is a graphical representation showing a time chart in the ignition timing control;

Figure 6 is a graphical representation showing a conceptual view of a shift operation;

Figure 7 is a flow chart of a shift control in the transmission control unit similar to Figure 2 but showing another embodiment of the present invention.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Hereinafter there will be described preferred embodiments of the present invention taking reference with drawings.

Referring specifically to Figure 1, there is shown a schematic view of a power plant of a vehicle to which the present invention can be applied.

The power plant is provided with an engine 1 and an automatic transmission 2. The transmission 2 is connected with at one end with the engine 1 through a torque converter 2a. The transmission 2 is connected at the other end with a wheel 8 through a propeller shaft 9 so that an engine output power or torque is transmitted to the wheel 8 with a predetermined speed ratio. An igniter 3 is connected with respective four cylinders of the engine 1 for providing ignition plugs 12 with firing signals. The transmission 2 is provided with a multiple transmission gear mechanism therein for establishing a plurality of shift gear stages automatically in accordance with a vehicle operating condition defined by an engine speed, an engine load obtained through such as throttle opening, a gear stage, an acceleration of the vehicle and the like. For this purpose, the transmission 2 is provided with shift solenoid valves 4, 5 and 6 which are adapted to control a hydraulic pressure for operating fictional elements therein so as to switch a power transmitting path of the gear mechanism. The transmission 2 is also provided with a lock-up control solenoid valve 7 for controlling an engagement and disengagement of a lock-up clutch provided in the torque converter 2a.

Internal structure of the transmission 2 and a hydraulic circuit for controlling the transmission 2 including the solenoid valves 4, 5 and 6 are well known as shown in U.S. Patent No. 4,779,491 and the U.S. Patent is incorporated into the present application by reference.

In order to control operation of the engine 1, there is provided an engine control unit 10 constituted by a microcomputer.

The engine control unit 10 receives as control factors a crank angle, throttle valve opening, engine temperature, braking signal denoting braking operation of the vehicle, knocking signal denoting an engine knock and produces engine control signal such as an ignition signal. Likewise, in order to

control operation of the transmission 2, there is provided with a transmission control unit 11. The transmission control unit 11 receives as control factors the throttle valve opening, vehicle speed, engine temperature, position of a shift lever showing a shift range currently selected, and the like. The transmission 2 controls the shift solenoid valves 4, 5 and 6 for carrying out a shift operation in which the gear stage of the multiple transmission gear mechanism is changed from one to another in accordance with a predetermined shift control map. General functions of the engine control unit 10 and the transmission control unit 11 are conventionally well known and they are not relevant to the features of the present invention so that the detailed explanation thereto are omitted.

A shift control signal from the transmission control unit 11 for controlling the shift solenoid valves 4, 5 and 6 is also supplied to the engine control unit 10. The engine control unit 10 receives the shift control signal and produces an ignition control signal for retarding an ignition timing in response to the shift operation so that the engine output torque is reduced during the shift operation of the transmission.

Hereinafter, there is described a retard control of an ignition timing in which the ignition timing is retarded in response to the shift operation.

Referring to Figure 2, a retard control of the ignition timing of the engine is shown. Steps S1-6 relate to a control for judging as to whether or not the engine output should be controlled in accordance with a running distance of the vehicle after starting driving operation in the current running operation. Steps S7-20 relate to a procedure for confirming whether or not the engine output control is preferably to be actually initiated in light of a time lag between the generation of the shift operation signal and an actual start of the shift operation. Steps S21-29 relate to a control for producing a retard control signal to the igniter 3 so as to retard the ignition timing for thereby reducing the engine output. The retard control signal is not produced to retard the ignition timing to reduce the engine output until a change in the time lag between the generation of the shift operation signal and the actual start of the shift operation in the transmission 2 becomes small in view of the running distance, or a transmission oil temperature as a result that the transmission oil is warmed up enough to provide a consistent time lag for the shift operation.

In control, the transmission control unit 11 resets a flag XOIL for denoting allowance of the retard control (S1). Then the transmission control unit 11 reads a throttle valve opening TVO and the vehicle speed (S2). The transmission control unit 11 detects the running distance of the vehicle so as to detect the oil temperature in the transmis-

sion 2 indirectly and to judge whether or not the judges whether or not the shift operation is ready to be made (S4). If the judgment is No or the running distance is less than a predetermined value (for example 3 Km), the transmission control unit 11 keeps the flag XOIL=0 and reads the shift control map (S5). In this case, the retard control is not carried out. On the other hand, when a cumulative number of the pulse denoting the vehicle speed is more than a predetermined value and it is found that the running distance exceeds the predetermined value, the oil temperature is deemed to be warmed up enough to provide a stable shift operation. In this case, the transmission control unit 11 judges that the retard control is ready to be initiated and sets the flag XOIL at a value of 2 (S6). The flag XOIL is increased when the shift operation from 1-2 or 2-3 stages occurs, when the time lag TOIL is less than a predetermined value and when the shift operation is made smoothly within a predetermined time period.

In step S7, the transmission control unit 11 judges whether or not the shift operation is to be made in light of the shift control map stored in a memory thereof (S7). If the judgment is No or, the shift operation is not to be made or the shift operation is being made, the control is returned to the starting step without any control. If the judgment is Yes or the shift operation is to be made, the transmission control unit 11 produces the shift control signals to the shift control solenoid valves 4, 5 and 6 to carry out the shift operation (S8). In this case, if the shift operation occurs between 1-2 stages or 2-3 stages, a shift flag XTIM is set at a value 1 (S11). If the shift operation occurs between two gear stages other than the 2-3 or 2-3, the shift flag is set at a value of 0 (S10). In this case, the control is returned to the starting step because the flag XOIL takes the value of 0 (S20) and goes to step S7. In step S7, it is judged that the shift operation is being made. This means that the judgment in step S7 is No. Therefore, the proceeding goes to the starting step again through the steps S12 due to the flag XOIL =0, S13 due to the flag XTIM=0 and S25.

On the other hand, if the shift operation occurs between the 1-2 or 2-3 stages, the flag XTIM takes the value of 1 and the flag XOIL takes the value of 0 so that the proceeding reaches step S7 again. In this case, the proceeding is advanced to step S14 because of the flag XOIL=0 (S12) and the flag XTIM=1 (S13). In step S14, the transmission control unit 11 judges whether or not the shift operation is actually initiated. In detail, when the shift operation is made between the 1-2 or 2-3 stages, the shift control signal is produced so that the solenoid valves 4, 5 and 6 are actuated. In this case, it takes a certain time lag before the oil or

hydraulic fluid in the transmission moves frictional element such as clutches to actually initiate the shift operation. In the course of the shift operation, the engine speed (turbine speed) changes as shown in Figure 6. When the accelerating operation is made by kicking an acceleration pedal down to increase the stroke thereof so as to increase the engine speed, the transmission control unit 11 produces the shift control signal to the solenoid valves 4, 5 and 6 in light of the shift control map. In this case, the engine speed continues to be increased for a certain time period after the shift control signal is produced. When the shift operation is actually initiated, the engine speed begins to be reduced. The engine speed is finally controlled to a value in accordance with a gear ratio of the gear stage selected as shown in Figure 6.

Where the shift operation is not initiated or an engine speed change  $dTREV$  is not a negative value, the time lag  $TOIL$  between the generation of the shift operation signal and the actual initiation of the shift operation is increased (S19). This proceeding continues until the engine speed change  $dTREV$  takes a negative value. In step S15, the value of the time lag  $TOIL$  is compared with a predetermined time period. If the time lag  $TOIL$  is greater than the predetermined value, that is when it takes long before the actual initiation of the shift operation, the flag  $XOIL$  is reset (S18). Then, the proceeding is returned to the starting step through the step S20.

On the other hand, where the time lag  $TOIL$  is smaller than the predetermined value or where the shift operation is deemed to be smoothly and stably made, the flag  $XOIL$  is increased and the proceeding is returned to the starting step through step S17. This proceeding is carried out repeatedly until the flag  $XOIL$  takes the value of 2 (until the shift operation between the 1-2 or 2-3 is completed smoothly and stably at least twice in series).

Once the retard control is deemed from the above procedure to be conditioned for being started, the retard control is carried out unless a prohibiting condition is established as enumerated in step S22, S23 and S24.

In proceeding the procedure for carrying out the retard control, the transmission control unit 11 sets a retard control counter  $T$  at a value zero (S20). The retard control counter  $T$  is provided for deferring a start of the retard control of the ignition timing by a predetermined time period after the shift control signal is generated. When the shift operation is to be a down shift from a fourth stage to a third stage, the retard control is not carried out because this down shift operation does not cause a serious torque shock inherently (S22). When the throttle opening is less than one-eighth, the retard control is not carried out because it may cause an

ignition fail (S23). Further, when the braking operation is made (a brake switch is On), the retard control of the ignition timing is not carried out (S24). In the case where the retard control is carried out, the transmission control unit 11 increases the value of the timer  $T$  (S26) until the value attains a predetermined value (S27). When the value of the timer  $T$  reaches the predetermined value, the transmission control unit 11 produces the retard control signal (S28). In step S29, the value of the timer  $T$  is reset.

Meanwhile, once the flag  $XOIL$  reaches the value of 2, the steps S14-S19 are skipped. Thus, the proceeding goes from the step S12 or S13 to the step S25.

Hereinafter, there is described the retard control by the engine control unit 10.

Referring to Figure 3, the engine control unit 10 receives as control factors the engine speed, the engine load (throttle opening) and the engine temperature (engine coolant temperature)(Q1) and determines a basic ignition timing  $\Theta B$  (Q2).

According to the illustrated embodiment, a retard angle  $\Theta ATR$  in the ignition timing is determined (Q8) in light of a map (not shown) stored therein when the engine temperature is higher than a predetermined value (72 centigrade in this embodiment) (Q3), the throttle valve opening  $TVO$  is greater than one-eighth (Q4), the braking operation is not detected (Q5) and the retard control signal is introduced from the transmission control unit 11 (Q6). In this case, a retard control flag  $FR$  is set at a value of 1 (Q9) and a retard period counter  $Tr$  is reset (Q10).

In step Q6, where the retard control flag  $FR$  is set at 1 even when the retard control signal is not introduced into the engine control unit 10 in the current processing cycle, it means that the retard control is now continued. Therefore, the retard period counter  $TR$  is increased (Q17) until it reaches a predetermined value (Q18).

On the other hand, where the retard control is not carried out, the retard angle  $\Theta ATR$  is set at zero (Q14) and the retard control flag  $FR$  is reset (Q15).

In step Q18, after the retard period counter  $TR$  reaches the predetermined value, the retard angle  $\Theta ATR$  is reduced by a value  $d\theta$  in each processing cycle (Q19) unless the retard angle  $\theta$  is reduced below zero (Q20). Finally, the retard angle  $\Theta ATR$  is set at zero. The retard control counter  $FR$  is reset (Q22).

After obtaining the retard angle  $\Theta ATR$  through the above procedure from step Q6 to Q22, the transmission control unit 11 determines a final ignition timing  $\theta$  through steps Q11 to Q13.

In step Q11, the transmission control unit 11 compares the retard angle  $\Theta ATR$  with a knocking

retard angle  $\theta_{NR}$  and uses a greater one as a final compensating angle  $\theta_R$  for the ignition timing  $\theta$  - (Q12, Q16). The final ignition timing  $\theta$  is obtained by adding the final compensating angle  $\theta_R$  to the basic ignition timing  $\theta_B$  (Q13).

Referring to Figure 4, there is shown a flow chart of a procedure for obtaining the knocking retard angle  $\theta_{NR}$  which is determined to suppress a knocking by controlling the ignition timing. The engine control unit 10 receives a signal from a knocking sensor (not shown) mounted on the engine 1 (R1). The knocking sensor is well known in the field of the present invention so that a detailed explanation thereto is omitted. For the purpose of the present invention, any kind of conventional knocking sensor can be employed. When the knocking is detected by the knocking sensor, the engine control unit 10 determines the knocking retard angle  $\theta_{NR}$  in accordance with an intensity of the knocking (R3). On the other hand, when the knocking is not detected, the engine control unit 10 reduces the knocking retard angle  $\theta_{ATR}$  by the value  $d\theta$  toward zero in each processing cycle (R2-R6).

Accordingly, when the shift operation is made from one gear stage G2 (for example 2nd stage) to another G1 (for example 1st stage), the retard control signal is introduced from the transmission control unit 11 to the engine control unit 10 after the predetermined period T from the generation of the shift control signal to the solenoid valves 4, 5 and 6 as shown in Figure 5. The retard control of the ignition timing continues for the predetermined time period  $T_R$  with the constant value of the retard angle  $\theta_R$  and thereafter the retard angle  $\theta_{ATR}$  is gradually reduced toward zero.

In this case, when the braking operation is made at a timing  $t_1$  at which the retard control signal is not introduced into the engine control unit 10, the retard control is cancelled. If the braking operation is made at a timing  $t_2$  at which the retard control is already initiated, the retard control is suspended immediately as shown in line 11 in Figure 5.

Referring to Figure 7, there is shown a flow chart of a shift control in accordance with another embodiment of the present invention. In this embodiment, the oil temperature for the transmission is directly detected and used for the control. The oil temperature can be detected any conventional ways. In the control, the transmission control unit 11 sets the flag XOIL at the value of 0 (S1) and reads the throttle opening TVO, the vehicle speed and the like (S2). Then, the transmission control unit 11 judges whether or not the oil temperature is higher than a predetermined value (100 centigrade in this embodiment) (S3). If the judgment is Yes or the oil temperature is higher than the predeter-

mined value, the flag XOIL is set at the value of 2 so that the retard control is conditioned to be made (S4). If the judgment is No, the transmission control unit 11 keeps the flag XOIL=0. In this case, the retard control is not carried out. In step S5, the transmission control unit 11 reads the shift control map and judges as to whether or not the shift operation is to be made in light of the shift map (S6). If the judgment in step S6 is Yes, the transmission control unit 11 produces the control signals to the solenoid valves 4, 5 and 6 for carrying out the shift operation (S7). If the judgment in step S6 is No, the proceeding is returned to the starting step. In step S8, the transmission control unit 11 judges whether or not the flag XOIL is the value of 2 and therefore the retard control is ready to be made. If Yes, the transmission control unit 11 carries out the same steps as the former embodiment shown in Figure 2. Namely, the transmission control unit 11 produces the retard control signal when the counter T reaches the predetermined value (S9-S15 in Figure 7). If No, the proceeding is returned to the starting step. Receiving the retard control signal, the engine control unit 10 carries out the retard control in accordance with the procedures shown in Figures 3 and 4 as aforementioned.

According to the above ignition timing control, the retard control is not carried out in the case where a specific vehicle operating condition in which a change in a time lag between a generation of the shift control signal and an actual initiation of the shift operation in the transmission is greater than a predetermined level is detected. However, this invention is not limited to this control but the retard angle  $\theta_{ATR}$  can be reduced in response to the specific vehicle operating condition.

It will be apparent from that many modifications and variations may be made based on the above descriptions by those skilled in the art without departing from the scope of the claims as attached.

## Claims

1. A control system for a vehicle comprising an automatic transmission provided with a multiple transmission gear mechanism in which a specific gear stage of a speed ratio is automatically established among a plurality of gear stages in accordance with an vehicle operating condition, shift control signal producing means for producing a shift control signal in order to make a shift operation between different gear stages in accordance with the vehicle operating condition, engine output control means for reducing an engine output in synchronism with the shift operation so as to suppress a torque shock due to the shift operation,

detecting means for detecting a specific vehicle operating condition in which a change in a time lag between a generation of the shift control signal and an actual initiation of the shift operation in the transmission is greater than a predetermined level and for producing a signal denoting the specific vehicle operating condition, and  
restricting means for restricting the engine output control means from reducing the engine output when said specific vehicle operating condition is detected.

2. A control system as recited in claim 1 wherein the shift operation in the automatic transmission is carried out by virtue of a hydraulic fluid, the detecting means detecting a parameter in connection with a viscosity of the hydraulic fluid.

3. A control system as recited in claim 2 wherein the parameter pertains to a temperature of the hydraulic fluid.

4. A control system as recited in claim 3 wherein the detecting means detects the temperature of the hydraulic fluid.

5. A control system as recited in claim 4 wherein the engine output is not controlled in connection with the shift operation when the temperature of the hydraulic fluid is lower than the predetermined value.

6. A control system as recited in claim 3 wherein the detecting means detects a running distance after starting driving operation so as to infer the temperature of the hydraulic fluid.

7. A control system as recited in claim 6 wherein the engine output is not controlled in connection with the shift operation when the running distance does not exceed a predetermined value.

8. A control system as recited in claim 3 wherein the detecting means detects the time lag between the generation of the shift control signal and the actual initiation of the shift operation between specific gear stages so as to infer the temperature of the hydraulic fluid.

9. A control system as recited in claim 8 wherein the engine output is not controlled in connection with the shift operation when the time lag is greater than a predetermined time period.

10. A control system as recited in claim 2 wherein the detecting means detects a running distance after starting driving operation and the time lag between the generation of the shift control signal and the actual initiation of the shift operation, the engine output being not controlled in connection with the shift operation when the running distance does not exceed a predetermined value and the time lag is greater than a predetermined time period.

11. A control system as recited in claim 1 wherein the engine output control means is constituted by ignition timing control means for control-

ling an ignition timing of the engine.

12. An engine control system as recited in claim 11 wherein the ignition timing control means carries out a retard control in which the ignition timing is retarded in response to the shift operation.

13. A control system as recited in claim 12 wherein a retard control signal for retarding the ignition timing is produced after a predetermined time period from a generation of a shift control signal for effecting the shift operation.

14. A control system as recited in claim 11 wherein a final ignition timing of the engine is calculated in accordance with a basic ignition timing which is determined based on an engine operating condition, a shift compensating value which is determined to reduce a torque shock due to the shift operation, and a knock compensating value which is determined to eliminate an engine knocking.

15. A control system as recited in claim 14 wherein the final ignition timing is compensated by a greater one of the shift compensating value and the knock compensating value.

16. A control system as recited in claim 1 further comprising switching means for switching a power transmitting path to change the gear stage from one to another in the automatic transmission, transmission control means for introducing a shift control signal to the switching means, engine output changing means for being actuated to change the engine output, engine control signal producing means for producing an engine control signal to the engine output changing means so as to change the engine output, said engine control signal producing means receiving the shift control signal from the transmission control means to change the engine output.

17. A control system as recited in claim 16 wherein said switching means comprises shift solenoid valves for switching a hydraulic path to establish a selected gear stage of the transmission, said engine output changing means comprising an igniter.

18. A control system for a vehicle comprising an automatic transmission provided with a multiple transmission gear mechanism in which a specific gear stage of a speed ratio is automatically established among a plurality of gear stages in accordance with an vehicle operating condition, shift control signal producing means for producing a shift control signal in order to make a shift operation between different gear stages in accordance with the vehicle operating condition, engine output control means for reducing an engine output in synchronism with the shift operation so as to suppress a torque shock due to the shift operation,

oil temperature detecting means for detecting a temperature of a hydraulic fluid in the automatic transmission, and

prohibiting means for prohibiting a control of the engine output by the engine output control means when the temperature of the hydraulic fluid is lower than a predetermined value.

5

19. A control system for a vehicle comprising an automatic transmission provided with a multiple transmission gear mechanism in which a specific gear stage of a speed ratio is automatically established among a plurality of gear stages in accordance with an vehicle operating condition.

10

shift control signal producing means for producing a shift control signal in order to make a shift operation between different gear stages in accordance with the vehicle operating condition,

15

engine output control means for reducing an engine output in synchronism with the shift operation so as to suppress a torque shock due to the shift operation,

20

running distance detecting means for detecting a running distance of the vehicle after starting driving operation, and

prohibiting means for prohibiting a control of the engine output by the engine output control means when the running distance does not exceed a predetermined value.

25

20. A control system for a vehicle comprising an automatic transmission provided with a multiple transmission gear mechanism in which a specific gear stage of a speed ratio is automatically established among a plurality of gear stages in accordance with an vehicle operating condition,

30

shift control signal producing means for producing a shift control signal in order to make a shift operation between different gear stages in accordance with the vehicle operating condition,

35

engine output control means for reducing an engine output in synchronism with the shift operation so as to suppress a torque shock due to the shift operation,

40

time lag detecting means for detecting a time lag between a generation of the shift control signal and an actual initiation of the shift operation between specific gear stages of the automatic transmission, and

45

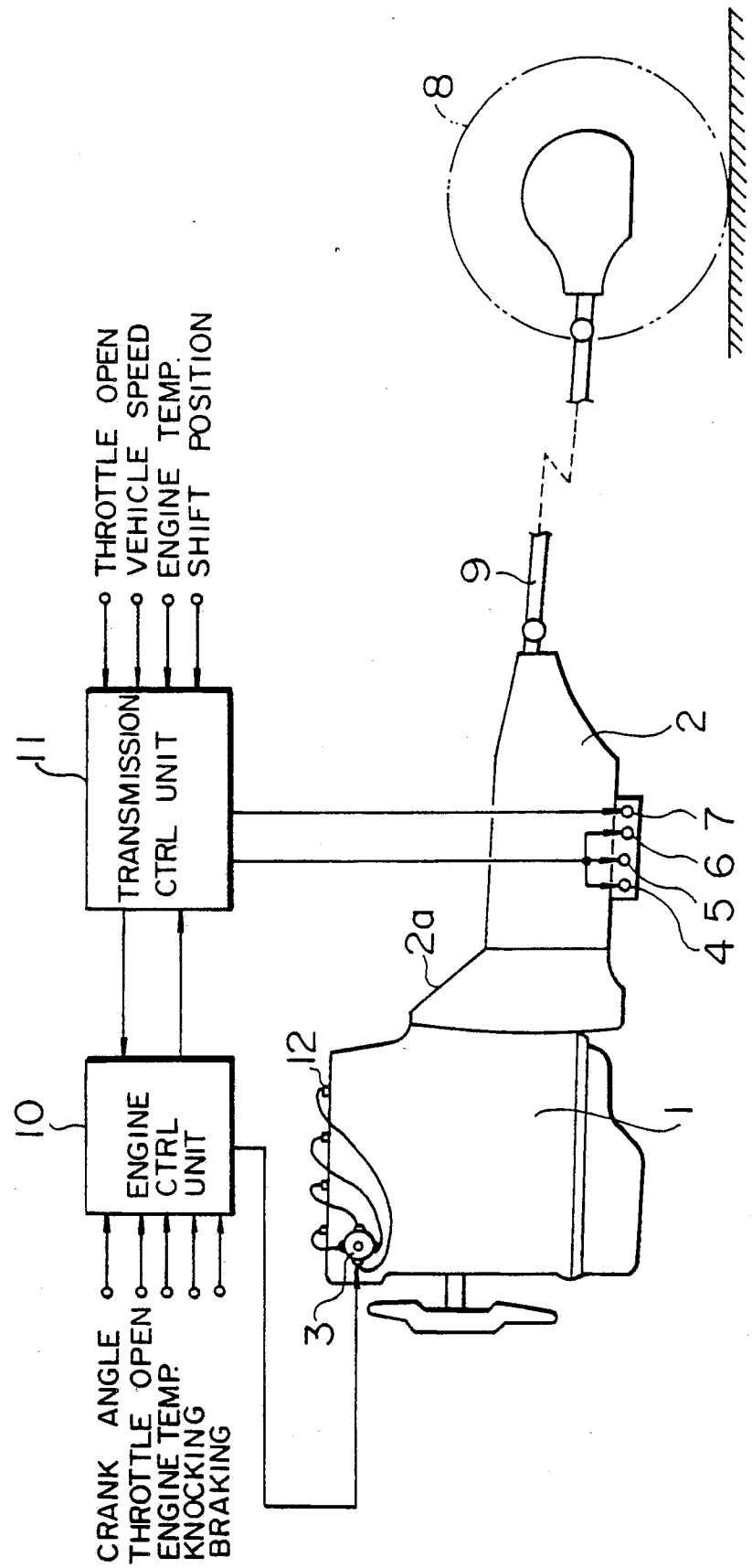
prohibiting means for prohibiting a control of the engine output by the engine output control means when the time lag is longer a predetermined time period.

50

55



FIG. 1



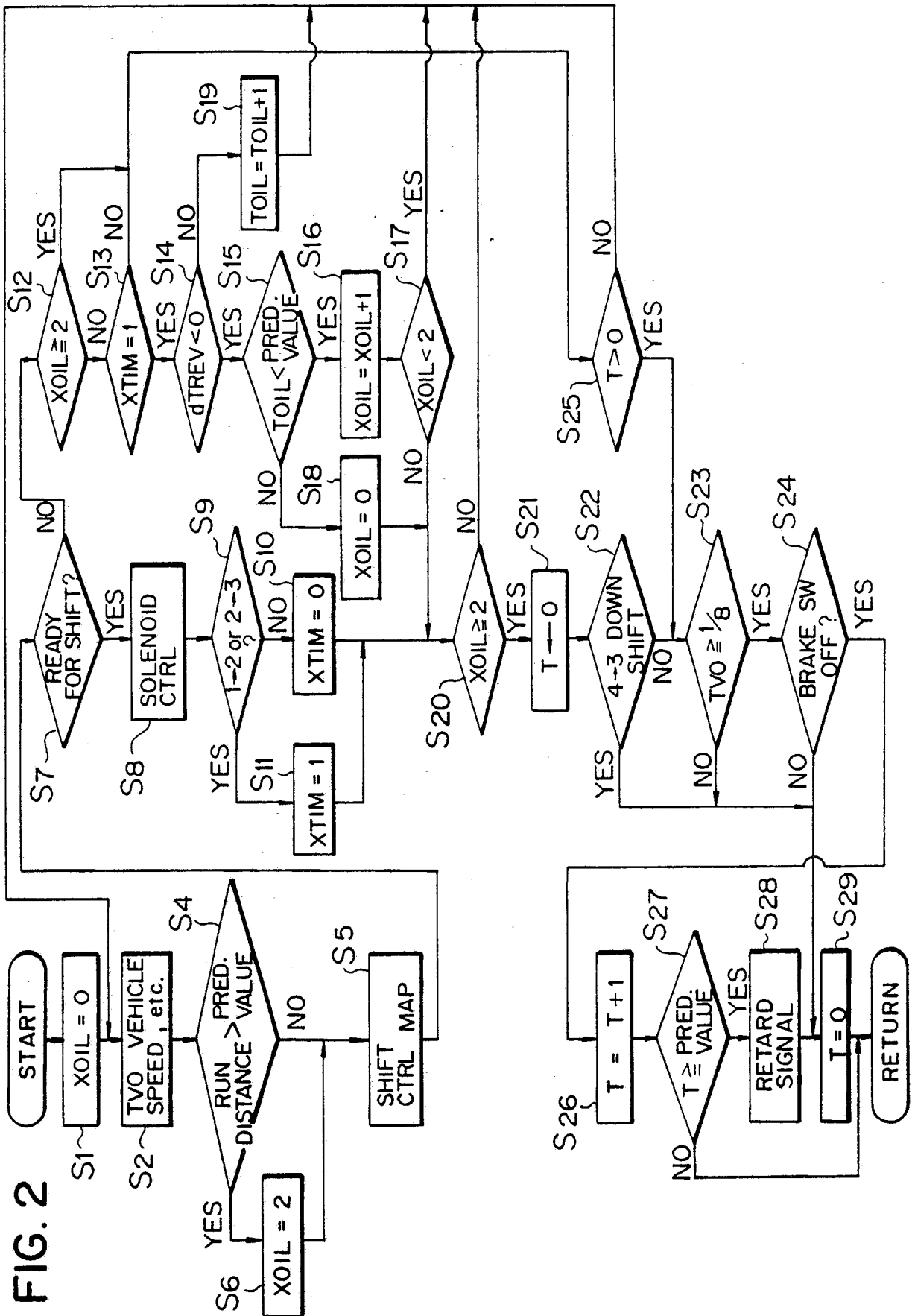


FIG. 3

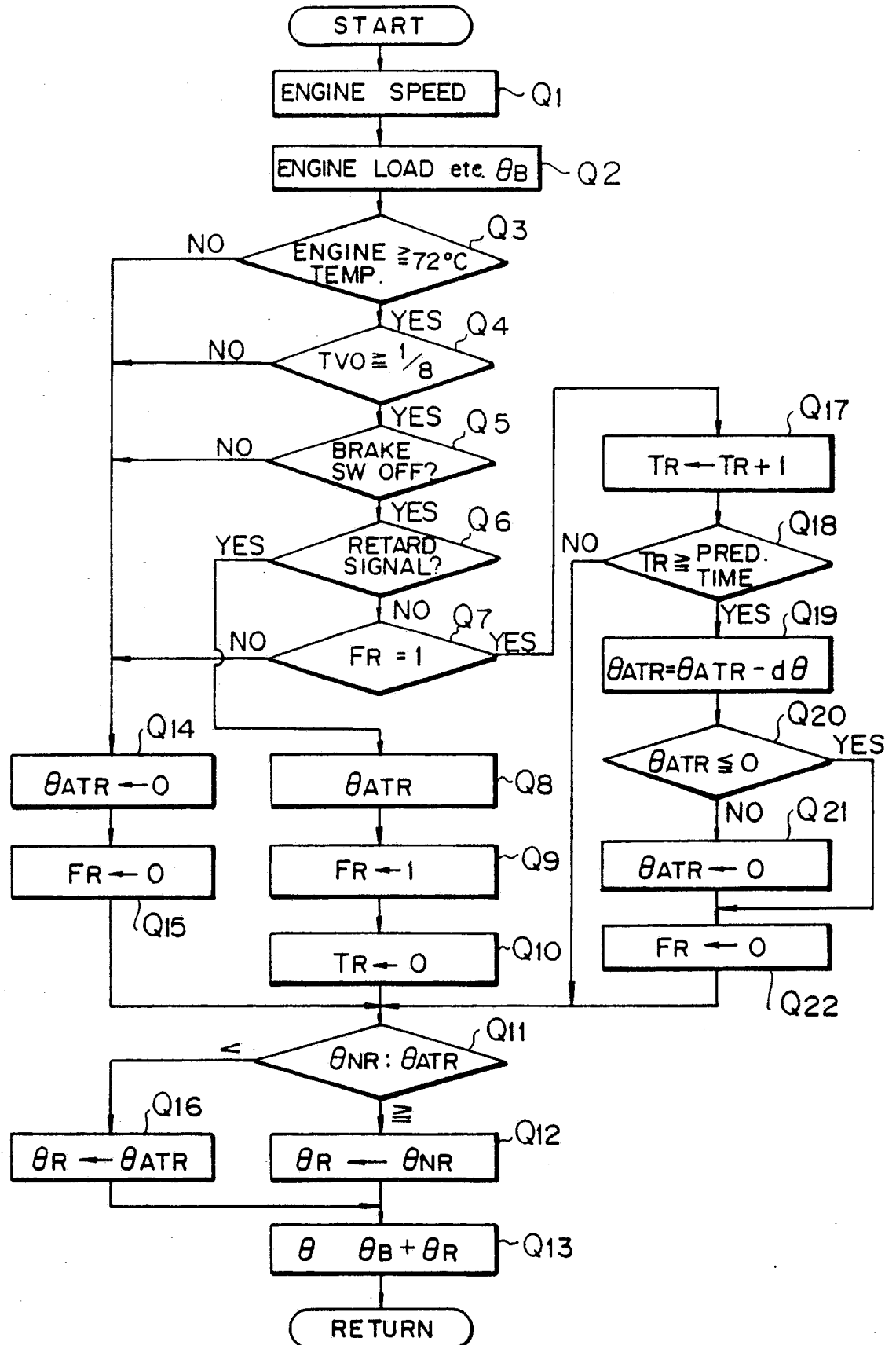


FIG. 4

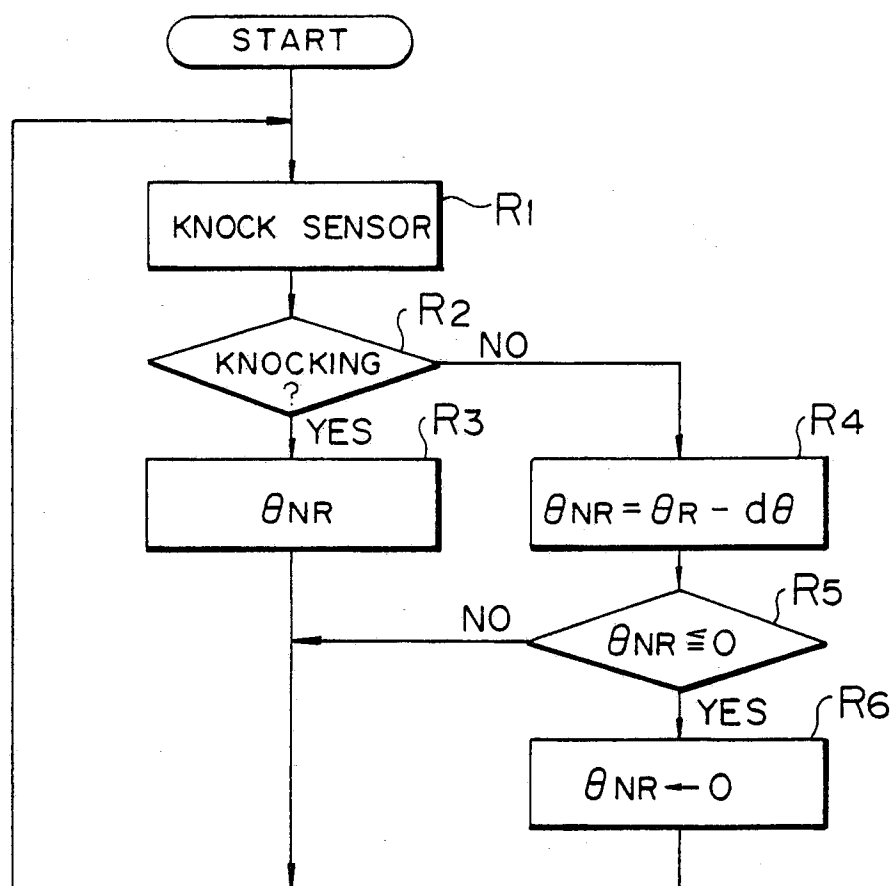


FIG. 5

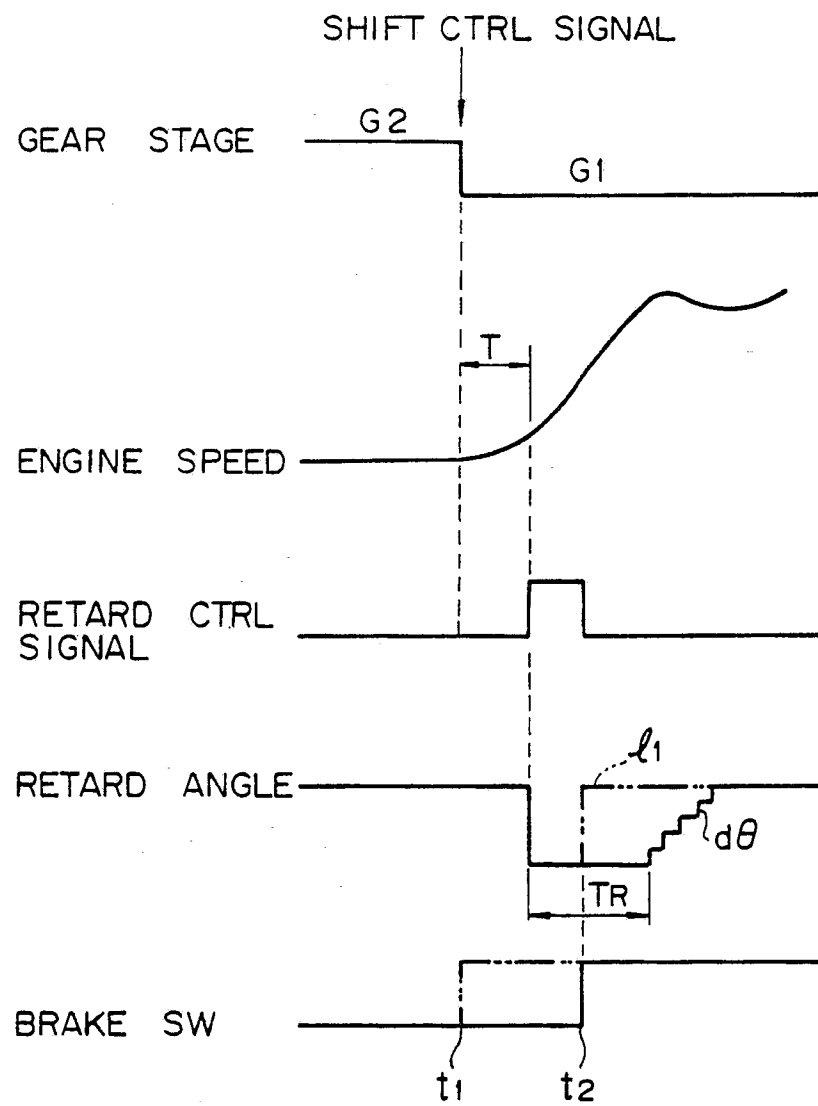


FIG. 6

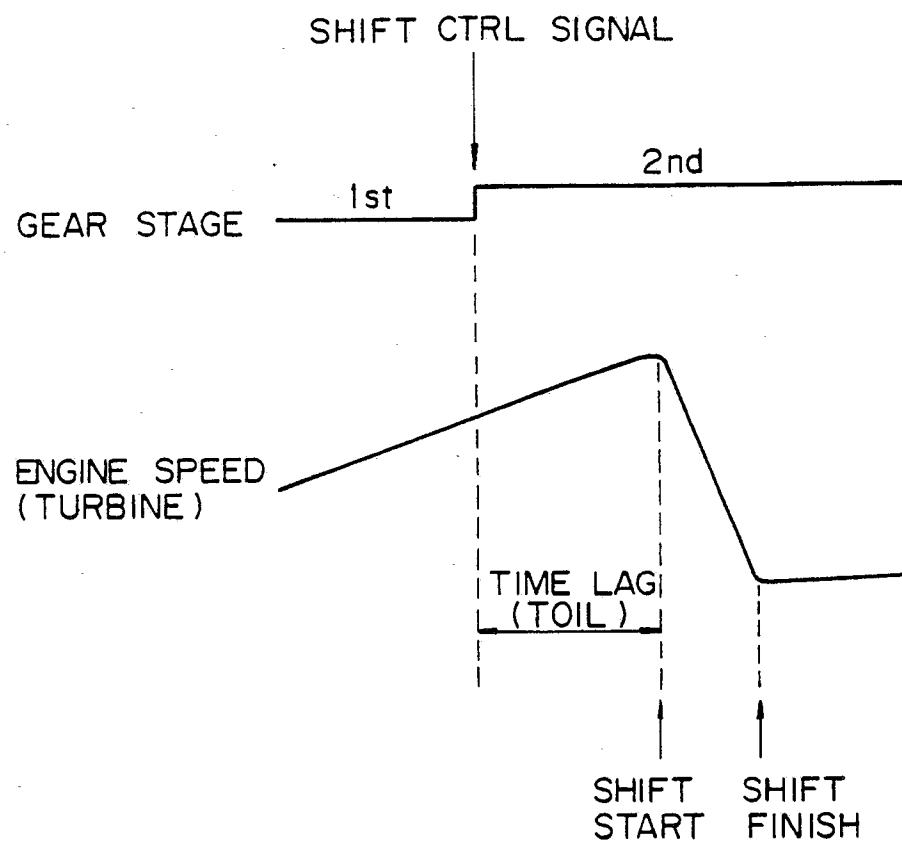


FIG. 7

